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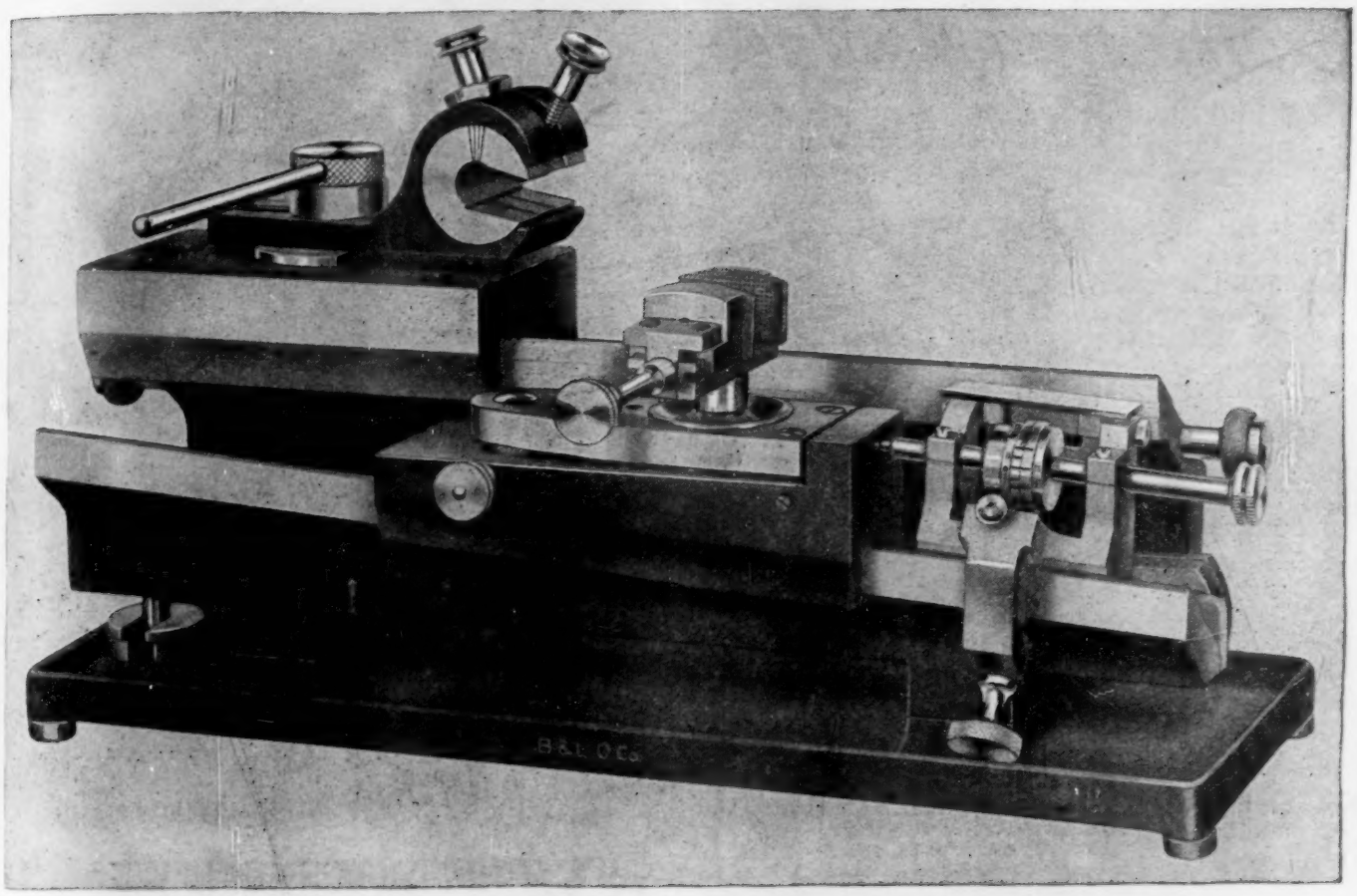

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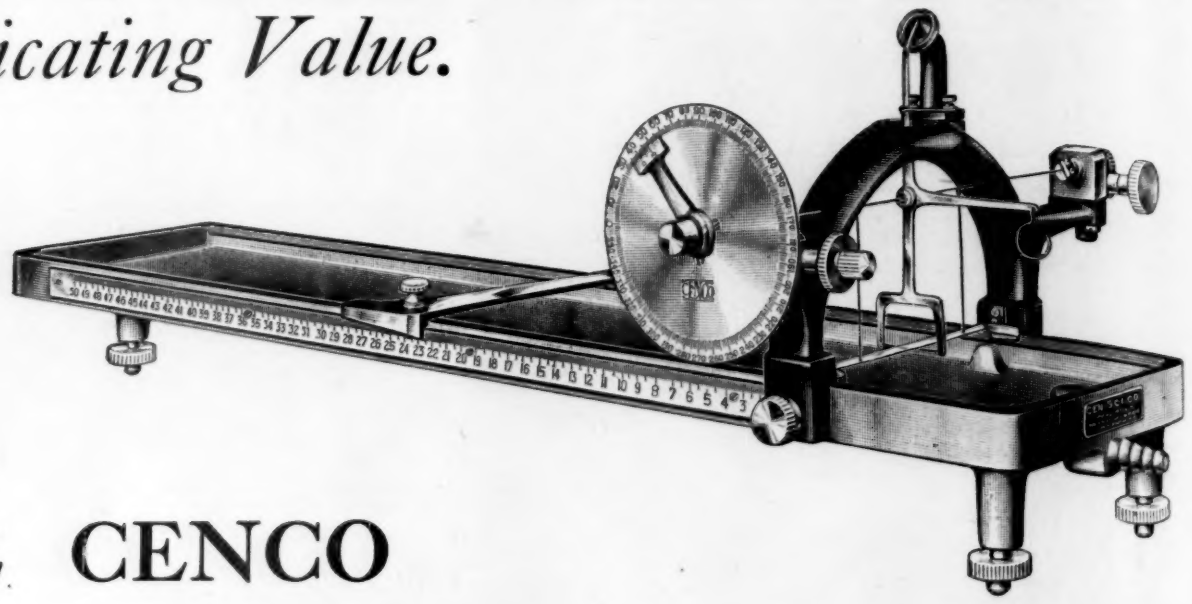

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AN ANTHROPOLOGIST LOOKS AT MEDICINE

By Professor E. A. HOOTON

HARVARD UNIVERSITY

INTRODUCTION

AN anthropologist looks at medicine very humbly, much as a cat may venture to look at a king. Moreover, the anthropologist, like Kipling's cat, walks by himself and all people are alike to him—even doctors—at any rate as long as he is feeling well. It happens that physical anthropology is the only field of knowledge which concerns itself exclusively with human biology, except medicine. Therefore, from the dim obscurity of speculations upon man's past, present and future, the anthropologist sometimes turns an appraising eye upon the practitioners of human biology—those who are not only studying man, but are also doing something to him.

DIFFERENCES BETWEEN PHYSICAL ANTHROPOLOGY AND MEDICINE

Certain differences between the methods and purposes of physical anthropology and of medicine condition the status of each and merit brief discussion. Medicine enjoys a uniquely favorable position among the sciences, because its activities are of immediate or potential concern to every human being. "How do you do?" is a conventional form of greeting, perfunctorily reechoed by way of response to every one except a doctor. There appertains to the healer a certain supernatural sanction, a legacy from the medicine man and the shaman. He works magic—not public magic, which is the province of the priest, and, as such, re-

ligion; but private magic for the benefit of the individual, which commands a fee. As the fearful sinner recognizes in the priest the personal agent of his soul's salvation, so does the suffering patient see in the doctor the instrument of his corporeal rehabilitation. Thus, each man's preoccupation with his own carcass—a sort of physiological egocentrism—gives medicine a distinct advantage over all other sciences. Medical research receives and deserves the most lavish financial support, since it is an investment which promises and pays the sort of dividends appreciated by all.

Physical anthropology, as I have intimated, is an unobtrusive and possibly innocuous growth in the field of human biology, a lonely and disregarded tare among the wheat. If it may aspire to be called a science, it is a pure science, in the sense that it is not applied—if not indeed purely useless. It is entirely untainted, because it has virtually no pecuniary contacts. Physical anthropology concerns itself with man's origin, present status and future evolution—problems which are of little or no concern to the individual in his pursuit of personal health and happiness. Physical anthropology is neither utilitarian nor idealistic, it is merely skeptical and speculative, in the etymological sense of each. It holds up a mirror to man and lets him look at himself, with the result that he likes neither his reflection nor the agent of its production. Medicine teaches, for whatever age or sex, what every man should know, and is discreetly silent upon matters of which a lay understanding is inexpedient. Anthropology reveals many things which most persons prefer not to know, since it harps upon humble and even bestial origins, regards the present status of our species without approbation, and can predict for the man of the future no apotheosis, but only a multiplication of psychoses, dental caries, malocclusions and fallen arches, together with a full retention of his aboriginal cussedness. Under these circumstances, anthropology not only misses the material opulence achieved by an applied science, but even the comfortable circumstances of a "popular science." Not for the anthropologist is the contemplation of the celestial grandeur of the expanding universe; he looks at one animal "bereft of his tail and grown weary of climbing"; he wonders why that animal carries so much excess baggage in the way of apparently unutilized brain, and whether he would not be better off with a smaller hat size and a set of lower and upper teeth which hit.

Now there are marked contrasts in the methods of physical anthropology and of medical science, arising no doubt from their diverse approaches to the problems of human biology. Medicine must focus upon the individual, for whom something has to be done, and that right quickly. Contact with suffering evokes sympathy and engenders an attitude of noble humanitarianism, rather than one of disinterested contemplation and appraisal. It is hardly a question of not seeing the wood for the trees, but rather one of sawing wood and selling timber or of giving it away. Since life is real, and ridiculously earnest, and the grave is a goal which the patient must be led to miss at all costs, medical science is nurtured in the fetid atmosphere of pathology, and has no chance to breathe pure ozone in the congregation of *mentes sanae in corporibus sanis* (sound minds in sound bodies). All of which is a cumbersome way of saying that doctors are so preoccupied with the sick that they do not know the well and are forced to evolve the normal from their inner consciousness, as the German scholar evolved the camel. Just as New England, according to Mark Twain, has no weather, but only samples, so medical science has no subjects but only patients. Inevitably this restriction results in a faulty conception of the range of "normal" human variation, a tendency to base conclusions upon the study of numerically inadequate samples and a failure to develop and to utilize valid methods of group analysis.

In contrast, the physical anthropologist is as little concerned with the bodily welfare of any given individual as the individual with that of the anthropologist. The anthropologist is interested in groups (the larger the better). Any member of a group commands his attention merely as a component unit, exhibiting a greater or less deviation from the mean. His business is to determine the range of variation of physical characteristics in large samples of the population, classified on an ethnic basis, a sociological basis or by whatever criteria the purpose of his specific investigation may suggest. Thus, a physical anthropologist may undertake to study Italians, an ethnic group; criminals, a sociological group; babies, an age group; mountaineers, a geographical group, *et cetera*. Or he may study Italian criminals, infant mountaineers or any group selected on the basis of several categories. In every instance, however, he must avoid confusion of categories by subdividing his material into groups which may be presumed to exhibit a certain physical homogeneity. There are, for example, certain physical variations which are determined by racial heredity. Therefore, the anthropologist, in studying criminals, would not throw Negroes and whites into the same statistical series; he would analyze them separately and eventually compare the constants and characters of their respective series. He would not include Italian and American babies in the same series, nor would he lump two-year-old infants with infants of three years, nor mountaineers with lowlanders. In the last two examples, differences of age or physical environment affecting bodily traits necessitate a careful sorting of

material, if group characteristics and trends are to be determined in any clear-cut fashion. Having delimited his group by such essential sortings in order to avoid confusion of issues, the anthropologist then proceeds to an examination of each component member of the group. He next advances to seriation and statistical analysis of the group data thus obtained, calculating the constants, recording the distribution of observed morphological characters, the intercorrelation of various features, and in every case taking into mathematical consideration the range of error introduced by the possibly inadequate size of the sample studied. He is then finally in a position to describe scientifically the physical characteristics of the group investigated. If, however, he wishes to go further and to differentiate between Italian criminals and Italians who are law-abiding citizens, or between mountaineers and plainsmen, he must repeat his analysis for each group adduced for comparison and must finally derive their differences from their respective arrays of characteristics.

Thus, if the anthropologist were investigating pneumonia, he would require: firstly, a large body of persons suffering from the disease; secondly, a sorting of the sufferers into statistical groups based upon race; thirdly, a further subdivision of the group, based upon age, and a possible fourth, based upon sex. All these subgroups would be subjected to separate statistical analysis before pneumonic characteristics could be scientifically isolated from confusing factors introduced by certain irrelevant biogenetic differences. But this is not all. The anthropologist would not feel that he really knew about pneumonia until he had compared his several subseries of affected subjects with similar groups of the non-infected population, each measured and analyzed in the same way. Then at last he would be in a position to reach scientific conclusions. Of course the doctor can not proceed along such investigatory channels. Before he had finished gathering his data, all his patients would have died or recovered —in either case without benefit of medicine. Such deliberate research can scarcely be undertaken by a practitioner who functions only during a crisis, and who is scientifically apathetic and professionally inert during periods of that condition described by the detestable term, "normalcy."

Nevertheless, the pedestrian methods of the anthropologist may eventually lead medical science to certain desired goals, possibly unattainable through mere utilization of the cumulative clinical experience gained by guidance of individuals through their bodily emergencies. I should like to discuss a few of the possibilities of practical contributions to medical science through the employment of anthropological methods.

PROBLEMS OF MEDICINE WHICH MIGHT BE ILLUMINATED BY ANTHROPOLOGICAL METHODS AND COOPERATION

(a) *Constitution.* The problem of constitution in its relation to medical science may be defined as the extent to which gross body type is correlated with immunity and susceptibility to various diseases. The relation of body type to disease is obviously only a part of the larger problem of the correlation of morphological variation with physiological variation, with psychological variation and with sociological behavior. Medicine has no immediate concern with some of the broader aspects of this question, although all of them engage the attention of the anthropologist. Lack of time, lack of knowledge and lack of inclination combine to prevent me from entering here into a history and critique of constitutional work in medicine, the substantial results of which, according to my possibly erroneous impression, are as yet regrettably slight. Nevertheless, I have the greatest confidence in the ultimate productiveness of research in this subject. My own positive findings respecting body build in its much farther-fetched relationship to type of crime have merely confirmed a conviction, gradually reached on other anthropological grounds. It is feasible, however, to define the essentials of correct scientific procedure in the investigation of the medical aspect of the problem—essentials, some of which, I fear, have been consistently disregarded in much of the work heretofore done. It is first of all imperative to diagnose completely and correctly the disease to be investigated. Foggy symptomatology will not do. If dementia praecox is a residuary legatee of all the bequests of psychiatric perplexity, it can hardly serve as a clinical point of departure for constitutional research. Assuming, however, that symptoms are clearly defined and diagnosis certain, it is next and equally essential that a valid scientific determination of body type be effected. Now, an actual establishment of an anthropological type, statistically demonstrable and irrefragable, is the most difficult and complex task which ever confronts a physical anthropologist. To attempt it with no more equipment than a clinical hunch and a pair of borrowed calipers is sadly ingenuous. Experience and a little mathematical knowledge will dissuade the most sanguine caliper-wielder from efforts to establish morphological types by a few raw measurements or crude indices, arbitrarily selected from the infinity of possible mensurable combinations. Type is a total morphological impression, a composite of dimensions, proportions and immensurable qualitative variations, synthesized by the brain, but through the eye, of the trained observer. Discernment of type is the ultimate acquirement of the

anthropological observer; its mathematical expression and demonstration, the most refined accomplishment of the expert biometrician. The former is useless without the latter. I can conceive of no more futile exercise than bandying about the clinic of anthropometrically unsubstantiated concepts, with dubious Greek names such as "pyknic."

The last prerequisite of a successful investigation of the problem of body build and disease is a competent method of statistical analysis, controlled by common sense and a full realization of the limitations of the data and of the ends to be achieved. The satisfactory application of such a method implies, of course, modern mechanical equipment for statistical reduction, plenty of computing assistance, together with sufficient resources, financial and moral, to carry on through years of arithmetic drudgery. There is no royal road to anthropometric analysis. The data must be sorted and analyzed, then resorted according to other categories and completely reanalyzed. This process of trial and error must continue until the possibilities of the data are exhausted. The investigator must be prepared ruthlessly to discard masses of data found to be inaccurate or irrelevant, and, if he is mathematically gifted, he must beware of the temptation to fiddle with formulae while research funds burn.

The requirements for success in constitutional study, as here laid down, are severe but not prohibitive, in view of the potential importance of the results.

(b) *Orthopedics.* The specialty known as orthopedics deals, in some degree, with bodily difficulties due to man's imperfect adaptation to an erect posture and to a biped mode of progression. Man is a made-over animal. In the course of evolution, his ancestors have functioned as arboreal pronogrades and brachiators, or arm-progressing tree-dwellers—not to mention more remote stages involving other changes of habitat, posture and mode of locomotion. This protean history has necessitated repeated patching and reconstruction of a more or less pliable and long-suffering organism. The bony framework has been warped and cramped and stretched in one part or another, in accordance with variations in the stresses and strains put upon it by different postures and by changes in body bulk. Joints devised for mobility have been readapted for stability. Muscles have had violence done to their origins and insertions, and have suffered enormous inequalities in the distribution of labor. Viscera have been pushed about hither and yon, hitched up, let down, reversed and inverted. In making a new machine out of an old one, plenty of obsolete spare parts have been left to rattle around inside. There are no few evidences of ungifted, amateur tinkering.

That the specialty of orthopedics should be based upon the very broadest knowledge and understanding of these evolutionary changes seems to me so obvious that I need not labor the point. The problems of body mechanics are in themselves tremendously complex. I suppose that no one lacking the training of an engineer can grapple with them effectively. Unless I am greatly mistaken, an adequate comprehension of bodily mechanics has not been achieved, as yet.

Two comparatively recent developments in experimental scientific facilities point the way for orthopedic progress. The first of these is the possibility of rearing the semi-erect and quadrupedal anthropoid apes in the laboratory, and of studying their postures and gaits from the point of view of bodily mechanics. These apes unquestionably illuminate the path of man's adaptations for erect posture and biped progression. It is hardly necessary to add that man himself, from infancy to senility, ought to be studied in the same way. The second modern development which facilitates orthopedic advance is the use of the x-ray photograph and the slow motion picture for the study of posture and gait and their mechanical implications. A full utilization of these technical devices for the observation of ape and human subjects, combined with anthropometric and clinical methods, can not fail to result in revelations of great practical value. Success will, however, necessitate protracted and expensive labor and a full employment of the resources of medical and anthropological science.

(c) *Pediatrics.* The study of the medical or hygienic treatment of children is, of course, an immense and valuable field of specialization. Pediatrics can pluck the heart-strings and the pocketbooks of the populace with greater facility than perhaps any other branch of medical science, because nature furnishes every normal human being with a special fund of sympathy for the young. An integral part of pediatrics is the study of human growth, which is indubitably bound up with the physiological crises and the pathological infestations of infancy, childhood and adolescence. No one, indeed, can claim that the study of human growth has been neglected of late in civilized countries. I fear, however, that much of this study has been ill-directed and purposeless, relegated for the most part to specialists in education or educational psychology (who are ready to try anything on some one else's child), to instructors in physical education and to anthropologists. Huge masses of statistics have been compiled and innumerable growth curves have been drawn, but the correlations of these data with nutritional status, with infections and with constitutional diseases are, I think, still to seek. Many growth studies have been carried on by persons who

have not been trained in the technique of anthropometry (which is by no means easy to acquire), and the measurements are consequently unreliable. The bulk of the subjects studied has not been assorted racially or even on the basis of national origins, so that the conclusions derived from the heterogeneous material are of dubious value. There are, of course, many exceptions to these generalizations, but, in my opinion, much of the effort expended in growth studies has been unintelligent and pointless. Such studies, unless undertaken for the simple purpose of demonstrating racial differences, should be so intimately associated with pediatrics as to furnish the controls and the knowledge of individual development with which to correlate the diseases and nutritional variations of childhood. This contention does not require further elaboration, because it has reached a status of almost general recognition.

However, I should like here to enter a plea in behalf of the study of age changes subsequent to adolescence. It is a lamentable fact that comparatively little is known of the terminal phases of the growth cycle (approximately between 21 and 25 years of age in males, and between 18 and 22 years in females). Actually we do not know when growth stops, nor when senile changes begin. There is a sort of general assumption that the final period of growth is succeeded by a resting phase, lasting for perhaps five years or more, after which senile decay insidiously sets in. Now it seems to me very probable that the physiological changes of middle life and old age are quite as intimately associated with disease, and consequently with medicine, as those of the advancing years of youth. The world is largely run by middle-aged and elderly individuals whose dispositions, bodily health and mental processes are presumably affected by senile changes. Consequently, it would seem that these age changes bring upon the population of every age-grade, wars, financial crises, diplomatic incidents, new deals and every other sort of social and economic evil. Hence, I venture to suggest the need of a science, or at least a medical specialty, of geratology, or the study of old age changes and their relation to disease. If the course of world events is to be altered because this old man has an enlarged prostate, that one has high blood pressure and the other has gastric ulcer or a wife going through the menopause, we have reason for desiring a somewhat fuller knowledge of the range, exact nature and general implications of bodily decline.

I will refrain from enlarging further upon relationships of anthropology and medicine, although there are many of an importance fully equal to those which I have discussed.

PROPOSAL FOR AN INSTITUTE OF CLINICAL ANTHROPOLOGY—A FOUNDATION FOR THE INVESTIGATION OF WELL BEINGS

All the foregoing considerations lead to a proposal which might profitably engage the serious consideration of medical science and of those great philanthropic foundations which alternately establish and allow to perish through inanition institutes for research to promote human betterment. In my opinion, the world is in sore need of an institute of clinical anthropology or, if you like, an institute of anthropological medicine, a foundation for the study of the biology of well beings. One might define such an institute as an organization devoted to the purpose of finding out what man is like biologically when he does not need a doctor, in order further to ascertain what he should be like after the doctor has finished with him.

I am entirely serious when I suggest that it is a very myopic medical science which works backward from the morgue, rather than forward from the cradle. I can see no bright future of scientific achievement for the healing art, if it persists in dealing only with those men who have stomachaches, and hypothecates its norms from them exclusively. The institute which I have in mind, would, of course, include physical anthropologists, whose techniques, methods of analysis and points of view I conceive to be essential to the enterprise. It would provide applications for their exact methods, too often wasted upon investigations which are, from a mundane point of view, relatively futile. The entire subject of human biology, apart from pathology, can not be investigated adequately by the physical anthropologist without the cooperation of medical science. There are in this country less than a dozen physical anthropologists who are paid to devote their entire time to this specialty, and there never will be a supply sufficient to cope with the task until an alliance with applied human biology is effected. On the other hand, there are enough and probably too many young men who are preparing to enter the medical profession, and a considerable number of them might advantageously be diverted from practice to clinical anthropological investigation. But I have intimated, and I now say quite flatly, that a medical education does not make its possessor competent to undertake research in physical anthropology, and that there seems little prospect of sound cultivation in the great field of human biology wherein may grow the nutritive plants essential for a greater materia medica, if that field is to be abandoned to the anthropologists rooting for something entirely different, and to the casual scratchings of medical leisure.

The purposes of such an institute for research in applied human biology might be enumerated as follows: to establish ranges, norms and variabilities in the fields of human morphology, physiology, psychology and neurology; to investigate age changes in man from his conception to his dissolution; to determine racial susceptibilities and immunities; to test the assumption of parallelism between human physiology and that of the higher mammals; to investigate human heredity and to apply the results of such research to medical practice; to lay the foundations for a rational science of eugenics. All these studies and many more might be undertaken with the avowed purpose of obtaining knowledge bearing directly upon medical practice, and it is medical science which would profit largely from them.

This paper is not intended to exhort medical sinners to an anthropological repentance; the anthropologist does not cast himself in the rôle of a John the Baptist, crying aloud in the wilderness—far less of a Messiah. Without any desire to crash the gates of your great profession, he peeps curiously between the bars, and comments—no doubt rashly—upon the laudable efforts of the inmates.

OBITUARY

WILLIAM ELWOOD BYERLY[1]

WILLIAM ELWOOD BYERLY was born in Philadelphia on December 13, 1849. He was educated by private tutors preparatory to entering Harvard, graduating from there with distinction in 1871. Returning to the graduate school for two years' further study, he received in 1873 one of the two first degrees of doctor of philosophy ever granted by the university. On leaving Harvard he was appointed assistant professor of mathematics at Cornell, where he remained for three years. He then returned to Harvard as assistant professor and in 1881 was promoted to full professorship. In 1905, on the death of J. M. Peirce, he was made Perkins professor. Because of threatened blindness Professor Byerly was forced to retire in 1913 from active university work, although his interest in education was undiminished until his death on December 20, 1935, at the age of eighty-seven.

Byerly's professional life was largely influenced by two unusual men. The first was Benjamin Peirce, who was Byerly's teacher both in the college and in the graduate school, and we may credit him with deciding Byerly to give his life to mathematical teaching. The second man was Evan W. Evans, his predecessor in the Cornell professorship.

Byerly's influence as a teacher was spread through his publications. Three years after commencing his work at Harvard he published "Elements of the Differential Calculus." His "Integral Calculus," a natural continuation of the "Differential," appeared in 1881. In 1893 he published "An Elementary Treatise on Fourier Series," "An Introduction to Generalized Coordinates" in 1916 and "An Introduction to the Calculus of Variations" in 1917.

Professor Byerly's contributions to education were not confined to his work at Harvard. In 1893 the National Education Association appointed a committee of ten, headed by President Eliot, to investigate teaching in American secondary schools. Byerly was vice-chairman of a subcommittee on mathematics and took a vital part in preparing their report. The total report of the committee was long held as an educational document of high significance.

An important part of Byerly's life work was his service in promoting the higher education of women, and he was actively interested in the movement which led ultimately to the establishment of Radcliffe College. Upon his retirement from active participation in the life of the college in 1913, President Eliot is quoted in part as saying "I can only say that he has been the most indispensable person connected with the growth and development of Radcliffe College."

However, there can be no doubt that Byerly's finest work in life was as a classroom teacher. He loved his subject and he loved his pupils, and the kernel of all his endeavor was the wish to make his pupils see the beauty and significance of the subject which was close to his heart. The key-note of his success was in the words "I love to teach." Through his teaching and writing he passed on inspiration in ample measure to a large number of grateful pupils who paid him in return with love and reverence.

[1] From a minute of the Faculty of Arts and Sciences, Harvard University.

GEORGE MELENDEZ WRIGHT

GEORGE MELENDEZ WRIGHT, chief of the Wildlife Division, National Park Service, was killed in an unavoidable automobile accident near Deming, New Mexico, on February 25.

Mr. Wright graduated from the University of California, College of Forestry, in 1927 but was particularly interested in wildlife protection. He became a ranger in Yosemite National Park, later serving as junior park naturalist. In 1929, at his own expense and with headquarters at Berkeley, California, he initiated a wildlife survey of the parks system to determine the existing status of animal life, help solve urgent park animal problems, and develop a wildlife policy for the National Park System. Four years

later, having published a valuable report ("Fauna of the National Parks," a preliminary survey of faunal relationships in national parks, National Park Service, Fauna Series No. 1, May, 1933, 157 pp.) he became associate field naturalist and chief of the Wildlife Division. Another report dealing with wildlife management in the national parks was published as a second unit in the fauna series in 1935.

Called to Washington to aid with emergency work, Mr. Wright directed the efforts of a committee which prepared the Recreation Section of the National Resources Board Report (now in press). Minor biological papers and notes have appeared in *The Condor, The Gull, The Scientific Monthly* and *The Journal of Mammalogy.* His writings, as well as his work, indicate a unique vitality and intellectual integrity. To him, perhaps, more than to any one else must go the credit for developing a concept of conservation in which man mingles with the other animals and maintains that priceless association by intelligently restraining his own acquisitive and reorganizing tendencies.

H. C. B.

RECENT DEATHS

PROFESSOR WILLIAM GILBERT MIXTER, who was a member of the faculty of Yale University for forty-five years, died on March 10. He was in his ninetieth year. Professor Mixter, who retired from active teaching in 1913, was known for his work in inorganic and thermal chemistry.

DR. WILLIAM HOLLAND WILMER, who was director of the Wilmer Ophthalmological Institute at the Johns Hopkins University from its founding in 1922 until his retirement in 1934, died on March 12 at the age of seventy-three years.

A CORRESPONDENT writes: "Dr. Kary Cadmus Davis, professor of the teaching of agriculture at the George Peabody College for Teachers, died on February 4 at the age of sixty-eight years. He was the first to receive the Ph.D. degree in agriculture (Cornell) in the United States. He was the author of some forty books on agricultural topics, and had taught at Peabody for twenty-two years."

JOHN SCOTT HALDANE, honorary professor and director of the Mining Research Laboratory of Birmingham University, died on March 15. He was seventy-six years old.

GEORGE THURLAND PRIOR, formerly keeper of the Department of Minerals at the Museum of Natural History, Kensington, London, died on March 8 at the age of seventy-three years.

SCIENTIFIC EVENTS

SCIENTIFIC MEN AND THE AGRICULTURAL ADJUSTMENT ADMINISTRATION

ACCORDING to a United Press dispatch, a number of scientific men connected with the U. S. Department of Agriculture have been stranded without money in out-of-the-way places throughout the world since the AAA was invalidated on January 6.

They were sent to their various posts to investigate methods of promoting agriculture in the United States. They searched for insects with which to combat farm blights such as the Mediterranean fruit-fly and for new plants which would aid in fighting water and wind erosion.

Several went to Hawaii to study conditions there and twenty others went to Puerto Rico. Others traveled to scattered points in Africa, India and South America. All, according to the dispatch, except a fortunate few who had built up a reserve fund of cash, were forced to exist on loans or the charity of friends since the AAA decision.

The dispatch continues:

> On January 6 the Supreme Court declared processing taxes invalid. Payments were halted on all items which previously had been paid from processing tax receipts. No more money was available.

AAA officials, mindful of the plight of the scientists, succeeded in having an item inserted in the deficiency appropriation bill setting aside $670,000 to carry on and complete the surveys—and, incidentally, provide salary payments to the scientists as well as sufficient money to bring them back to this country. The bill was approved on February 11.

The money thus far has not been made available to the AAA or to the Department of Agriculture, however, because Comptroller-General John R. McCarl questions whether continuation of the project is legal under the court's ruling.

IN HONOR OF PROFESSOR CHANCEY JUDAY, OF THE UNIVERSITY OF WISCONSIN

FRIENDS of Professor Chancey Juday gathered at dinner on Friday, February 28, at the Memorial Union of the University of Wisconsin, to celebrate the thirtieth anniversary of his service with the Natural History Division of the Wisconsin Geological Survey. Professor Juday has conducted his researches on fresh-water lakes continuously since 1905. Having been president of the Microscopical Society and the Ecological Society, he was elected first president of the American Limnological Society, which was founded at St. Louis in June, 1935.

The investigations of Dr. Juday have covered a wide range, extending from the Finger Lakes of New York to inland lakes of Indiana, California and Central America. However, most of his studies have dealt with the almost innumerable inland lakes of Wisconsin; he has visited several hundred of these lakes in all parts of the state. The most extensive studies have been made on the lakes near Madison, on Green Lake, and, during the past decade, on the lakes of northeastern Wisconsin.

It may be said that the limnology laboratory at Trout Lake, which was established under the direction of C. Juday and E. A. Birge, and their laboratory at the University of Wisconsin are the oldest limnological laboratories in the United States. From the variety of correspondence which is received, one may conclude that Juday's contributions to the literature of limnology have penetrated most quarters of the globe. Just as it is difficult to mention Juday without including Birge, with whom he is associated in most of his research work, so it is equally difficult to mention limnological research without suggesting the cooperative element in the investigations. In response to the well-wishes of his friends on the occasion of the dinner, Professor Juday discussed the essential relationships which exist between the various fields of science in a limnological investigation and took the opportunity to thank his colleagues, who through their contributions had helped make his research so pleasant and profitable.

V. W. M.

THE GOLDEN JUBILEE OF ALUMINUM

ACCORDING to *Industrial and Engineering Chemistry,* Arthur Vining Davis, chairman of the board of the Aluminum Company of America and early associate of Charles Martin Hall, spoke before a gathering at the Waldorf-Astoria on February 17 to celebrate the golden jubilee of aluminum, held under the joint auspices of the Electrochemical Society and the Aluminum Company of America. "All developments of the kind," Mr. Davis said, "divide themselves into four eras or epochs, each characterized by the question uppermost in the minds of the developers. Ours were: (1) Can we make aluminum? and this we were able to answer in the affirmative as soon as our production reached 30 pounds per day. (2) What can we do with what we have made? which became an early problem as our output, small as it was, piled up on our hands and was answered by making novelties of it. (3) Can we make any money on it? which was finally answered by our going into the business of doing our own fabricating. (4) How can we make the business grow? which still keeps us searching actively for new markets through research, despite the fact that our present production is in the neighborhood of 300,000,000 pounds per year."

Present at the meeting as guests of honor were seven of the fifteen living Perkin Medalists: F. M. Becket, C. F. Burgess, F. G. Cottrell, George O. Curme, Jr., Colin G. Fink, E. C. Sullivan and M. C. Whitaker. James H. Critchett, president of the Electrochemical Society, turned the meeting over to F. C. Frary, director of research of the Aluminum Company of America, who acted as toastmaster and who traced the early history of Hall's development of the electrolytical production of aluminum in an anhydrous bath. The other speakers were H. H. Johnson, a classmate of Hall's at Oberlin College and a lifelong friend of the inventor; F. M. Becket, of the Electrometallurgical Corporation, who spoke on fifty years of research, and Alexander Klemin, of the Guggenheim School of Aeronautics, who emphasized the importance of aluminum and its alloys in modern transportation through the air. The occasion marked the fiftieth anniversary of Hall's first successful experiments and the twenty-fifth of his designation as Perkin Medalist in 1911. An account of Hall's work will be found in the issue of SCIENCE for February 21, 1936.

THE ELDRIDGE REEVES JOHNSON FOUNDATION LECTURES

THE lectures of the Eldridge Reeves Johnson Foundation for Medical Physics in the University of Pennsylvania will be given this year by Dr. Joseph Erlanger, professor of physiology in the Washington University Medical School, and Dr. Herbert S. Gasser, director of the Laboratories of the Rockefeller Institute for Medical Research.

The subject of the series will be "Electrical Signs of Nerve Activity." The lectures will be given in the laboratories of the School of Medicine at 4:15 P.M., from March 31 to April 7, as follows:

March 31: "Introduction," Drs. Erlanger and Gasser.
April 1: "The Analysis of the Compound Action Potential of Nerve," Dr. Erlanger.
April 2: "The Comparative Physiological Characteristics of Nerve Fibers," Dr. Erlanger.
April 3: "Some Reactions of Nerve Fibers to Electrical Stimulation," Dr. Erlanger.
April 6: "Sequence of the Potential Changes," Dr. Gasser.
April 7: "The Irritability Cycle," Dr. Gasser.

The purpose of the Johnson Foundation is to further research in the physical aspects of the medical sciences and generally to develop the relation and application of physics to medicine. As a part of these activities the lectures were begun in 1930 as a means for presenting from time to time outstanding scientific advances in such fields of investigation. In

1930 the lectures were given by Professor A. V. Hill of the University of London and in 1931 by Professor E. D. Adrian of Cambridge University.

THE SIGMA XI SEMI-CENTENNIAL AT CORNELL UNIVERSITY

SIGMA XI, national scientific honor society with sixty-six chapters in American colleges and universities, will celebrate at Cornell University on June 19 and 20 the fiftieth anniversary of its founding. *The Cornell Alumni Weekly* reports that as a part of the program a bronze memorial tablet, provided by the society, will be unveiled on the campus near Sibley College on a commemorative bench and pedestal which the university will erect.

The program at Ithaca will be sponsored jointly by the Society of Sigma Xi and the American Association for the Advancement of Science, the summer meeting of which will convene in Rochester that week. Dr. Max Mason, retired president of the Rockefeller Foundation, will make the principal address at the commemorative exercises. Other speakers will be Dr. Karl T. Compton, president of the Massachusetts Institute of Technology; Dr. Willis R. Whitney, of the General Electric Company, and Dr. Frank R. Lillie, of the University of Chicago, chairman of the National Research Council and president of the National Academy of Sciences.

Two semi-centennial research prizes of $1,000 each will be awarded by the society, one to a worker in the physical sciences and one to a worker in the biological sciences.

Sigma Xi was founded at Cornell University in the fall of 1886 through the efforts of Frank Van Vleck, then assistant to the director of Sibley College and instructor in charge of the mechanics laboratory, and William A. Day, '86, who had conceived the idea of a "scientific Phi Beta Kappa" the spring before. At about the same time, Professor Henry Shaler Williams, of the department of geology, had organized a society of fourteen students with much the same purposes, and he prevailed upon Drs. Van Vleck and Day to broaden somewhat their original idea and became the first president.

Professor Floyd K. Richtmyer, '04, is chairman of the local committee on arrangements.

MEETING OF THE SOUTHWESTERN DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE sixteenth annual meeting of the Southwestern Division of the American Association for the Advancement of Science will be held at Flagstaff and the Grand Canyon, Arizona, from Monday to Thursday, April 27, 28, 29 and 30. The meeting is under the auspices of the Arizona State Teachers College, the Lowell Observatory, the Museum of Northern Arizona, the United States National Park Service and the Grand Canyon National Park. With the branch will meet the Third Annual Tree Ring Conference (*chairman*, A. E. Douglass, Tucson) the Society of American Foresters, Southwestern Section (*chairman*, G. A. Pearson, Tucson) and the Southwestern Conservation League (*president*, C. M. Botts, Albuquerque).

Meetings of the Southwestern Division will this year be divided between Flagstaff and the Grand Canyon. Flagstaff is situated on main transcontinental highway and railroad lines, high in a heavily forested section of the state. The Grand Canyon is but a brief automobile or train ride from Flagstaff.

The presentation of scientific papers under the several sections of the division is invited, and for participation neither membership in the association nor residence within the boundaries of the division is required. Officers directly in charge of the meetings of the sections are as follows:

Biological Sciences:
Chairman, J. R. Eyer, State College, New Mexico.
Secretary, R. H. Canfield, Alamogordo, New Mexico.
Mathematics:
Chairman, F. W. Sparks, Lubbock, Texas.
Secretary, W. C. Risselman, Flagstaff, Arizona.
Physical Sciences:
Chairman, S. B. Talmage, Socorro, New Mexico.
Secretary, W. M. Craig, Lubbock, Texas.
Social Sciences:
Chairman, E. W. Haury, Globe, Arizona.
Secretary, J. H. Provinse, Tucson, Arizona.

The following program has been arranged:

MONDAY, APRIL 27, FLAGSTAFF

Morning: Registration and General Session.
Afternoon: Section Meetings, 1:30 to 3:30 P. M.
Inspection of new home of the Museum of Northern Arizona and a tea given by Dr. and Mrs. Harold S. Colton.
Evening: Dinner, under auspices of Flagstaff Sigma Xi Society.
Visit to Lowell Observatory.

TUESDAY, APRIL 28, FLAGSTAFF

Morning: Section Meetings.
Afternoon: Section Meetings.
Short excursions to Sunset Crater (geological); to Winona (archeological), and to Oak Creek Canyon (general interest).
Evening: Annual Dinner of the Division, Presidential Address by Dr. H. S. Colton.

WEDNESDAY, APRIL 29, FLAGSTAFF AND GRAND CANYON

Morning: Section Meetings.
Afternoon: Business Meeting.
Drive to Grand Canyon.

Evening: Dinner at El Tover Hotel.
Powell Lecture by Dr. J. C. Merriam.

THURSDAY, APRIL 30, EXCURSIONS AT THE GRAND CANYON

Morning: Visit to Yavapai Point Observation Station followed by drive along Hermit Rim Road (Trip "B"). Visit to Yavapai Point Observation Station followed by all day trip down Kaibab Trail to the Colorado River (Trip "D").

Afternoon: Visit Grandview and Moran Point, and Wayside Museum of Archeology (Trip "C").
Evening: Lecture and entertainment.

The officers of the Southwestern Division are: *President,* H. S. Colton, Museum of Northern Arizona, Flagstaff; *Vice-president,* Jesse Nusbaum, Mesa Verde National Park; *Secretary,* V. C. Kiech, University of New Mexico, Albuquerque.

SCIENTIFIC NOTES AND NEWS

DR. CHARLES L. REESE, formerly director of the E. I. du Pont de Nemours and Company, on the occasion of the fiftieth anniversary of receiving the doctorate of philosophy from Heidelberg University, received the following letter from Dean A. Seyboldt: "Fifty years have passed on the twenty-sixth of February since you were promoted in Heidelberg to doctor of philosophy. Robert Bunsen was your teacher together with Hermann Kopp and August Beruthsen. We know you have retained a friendly remembrance of your teachers as well as of Heidelberg and of the country whose guest you were at that time. The university, which will celebrate the five hundred and fiftieth year of its existence shortly, is thinking to-day of its pupil. You have contributed in a measurable manner to the building of the chemical industry of your country. The two largest scientific associations of your branch have chosen you as president. The University of Heidelberg and especially the faculty of natural science and mathematics congratulate you on the great success of your life and hopes you will continue to have good years. With the same mail, I am sending you a renewal diploma of doctor of natural science."

DR. GEORGE GRANT MACCURDY, of Yale University, and director of the American School of Prehistoric Research, has been elected to honorary membership in the British Speleological Association. Dr. MacCurdy has also been delegated to represent the Southwest Museum, Los Angeles, Calif., at the International Congress of Prehistoric and Protohistoric Sciences to be held in Oslo, Norway, during the month of August.

DR. OLIVER R. WULF, of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, is the recipient of the Hillebrand award "for outstanding research." The award is made by the Washington section of the American Chemical Society, in recognition of his work on the origin of ozone in the upper atmosphere.

LIEUTENANT LEONARD CHARLES HILL, the master of the *R.R.S. Discovery II,* has been appointed an Officer of the Civil Division of the Order of the British Empire for his services in connection with the search in the Antarctic for Lincoln Ellsworth and Herbert Hollick-Kenyon.

PROFESSOR LUDWIG ASCHOFF, professor of pathologic anatomy in the University of Freiburg in Breisgau, celebrated his seventieth birthday on January 10.

A FLORIDA ACADEMY OF SCIENCE has been founded by members of the University of Florida, the Florida State College for Women and the University of Miami. A charter was applied for and granted in February. The officers are: *President,* Dr. Herman Kurz, botany, Florida State College for Women; *Vice-president,* Dr. Robert C. Williamson, physics, University of Florida; *Secretary,* Dr. J. H. Kusner, mathematics, University of Florida; *Treasurer,* Dr. J. F. W. Pearson, zoology, University of Miami.

DR. HANS ZINSSER, professor of bacteriology and immunology at the Harvard Medical School since 1923, has been appointed Charles Wilder professor of bacteriology and immunology. He succeeds Professor Milton J. Rosenau.

DR. ARTHUR MICHAEL, who has been professor of organic chemistry at Harvard University since 1912, has resigned and has been appointed professor emeritus.

PROFESSOR GEORGE P. BACON, since 1929 dean of the engineering school of Tufts College, has resigned. He was previously for ten years head of the department of physics.

DR. HENRY JOHNSON LONG has recently been named president of Greenville College, Greenville, Ill., succeeding Dr. Leslie Ray Marston, who resigned to become bishop of the Free Methodist Church of North America. Dr. Long, a native of Oklahoma, has been professor of chemistry at Greenville since 1927 and prior to that was professor of chemistry at Central College, Kans., and assistant instructor in chemistry at the University of Kansas.

DR. C. O. EDDY, associate entomologist of the Ken-

tucky Agricultural Experiment Station, has joined the staff of the Louisiana Agricultural Experiment Station as head of the department of entomology.

PROFESSOR JOHN KAY JAMIESON has been appointed to the chair of human anatomy and embryology at the University of Dublin made vacant by the death of Dr. Andrew Francis Dixon. Dr. Jamieson has been professor of anatomy since 1910 and dean of the School of Medicine at the University of Leeds since 1918. He is a member of the General Medical Council.

JOHN C. PAGE, chief engineer of the Reclamation Bureau, has been appointed to relieve R. F. Walter as acting reclamation commissioner. Mr. Walter, who had been in charge of the bureau since the death of Commissioner Elwood Mead, has returned to Denver to resume his work there.

CHESTER CHARLES DAVIS, administrator of the Agricultural Adjustment Administration, has been requested by President Roosevelt to make a survey of the economic policies of European nations. Mr. Davis sailed for Europe on March 20, to be absent for two months. Dr. H. R. Tolley, director of the Giannini Foundation of the University of California, who has been assisting Mr. Davis, has been appointed acting director. He will be in charge of developing the programs under the new Soil Conservation and Domestic Allotment Act.

HARRY A. NOYES, chemist and bacteriologist, has joined the staff of Arthur D. Little, Inc., consulting chemists and engineers of Cambridge, Mass., as a food technologist.

THE Committee on Research of the American Medical Association has awarded grants as follows: To Dr. H. E. Eggers, professor of pathology at the University of Nebraska College of Medicine, for the prosecution of his work on the effect of tetramethylarsonium gluconate on cancer; to Dr. Gustav J. Martin, of the Trudeau Sanatorium, New York, for the study of the lipoids of the tubercle bacillus to determine the chemical basis of virulence in the tubercle bacillus, and to Drs. Lester R. Dragstedt and G. M. Dack to aid them in the study of the relation of *Bacterium necrophorum* to chronic ulcerative colitis. The work will be done in the laboratories of bacteriology and hygiene, surgery and medicine, of the University of Chicago.

DR. CHARLES FINLAY sailed from New Orleans for his home in Havana on March 4. Dr. Finlay had been in New Orleans to attend the recent Southeastern Surgeon's Congress.

IN addition to members of the faculty of the Harvard College Observatory the staff of the Summer School of Astronomy in 1936 will include among its visiting lecturers: Dr. Peter van de Kamp, University of Virginia; Dr. Alfred C. Lane, Tufts College; Dr. Knut Lundmark, University of Lund, Sweden; Dr. Paul W. Merrill, Mount Wilson Observatory; Dr. Henry Norris Russell, Princeton University; Dr. Megh nad Saha, University of Allahabad, India, and Dr. Frank Schlesinger, Yale University.

DR. STEPHEN REID CAPPS, geologist of the Alaskan branch of the U. S. Geological Survey, gave the Grant Memorial Lectures on February 25, 26 and 27 at Northwestern University.

DR. GEORGE H. PARKER, emeritus professor of zoology at Harvard University, gave an illustrated lecture on "Coloring in Animals" on March 4 before the Lancaster Branch of the American Association for the Advancement of Science. On the following day he addressed the Pre-Medical Club at Lafayette College on "Animal Coloration and the Nervous System."

AT a recent open meeting of the Dartmouth Scientific Association, Professor M. L. Fernald, of Harvard University, was the guest speaker. The subject of his address was "Plant Survivors of Continental Glaciation in Eastern America."

PROFESSOR FAY-COOPER COLE, of the department of anthropology of the University of Chicago, spoke on February 27 on "An Anthropologist's Concept of Race" at the Iowa State College. On February 26, as guest of Sigma Xi, he spoke on "The Coming of Man."

THE annual lecture to initiates at the University of Pittsburgh Chapter of the Society of the Sigma Xi was given this year by Professor William C. Rose, of the department of biochemistry of the University of Illinois on February 26. The title of his address was "The Nutritive Rôle of the Amino Acids."

DR. HARLAN T. STETSON, of Harvard University, lectured on "The Sun's Effect on Human Affairs" under the auspices of the Sigma Xi at the Worcester Polytechnic Institute on March 16. Dr. Stetson spoke on the same topic on February 20 at the Academy of Science and Arts at Pittsburgh.

THE American Astronomical Society will meet in Cambridge, Mass., from September 2 to 5. At this meeting there will be special addresses by Sir Arthur Eddington, Dr. Antonie Pannekoek and Professor Henry N. Russell as contributions to the Tercentenary Conference.

THE ABBÉ H. BREUIL, authority on Old World prehistory, will be in charge of the 1936 summer term of the American School of Prehistoric Research. He will be assisted by Harper Kelley, a former student

of the school. The term will open in Paris on July 1. The tentative program includes lectures, museum studies, practise in excavating and excursions to important prehistoric sites in various parts of France, Spain and England. The term will close in England the latter part of August. Prospective students should apply for enrolment before the end of March, sending their applications to Dr. George Grant MacCurdy, director of the American School of Prehistoric Research, Old Lyme, Conn.

DURING the seventeenth annual meeting of the American Geophysical Union the Section of Seismology will hold joint sessions in Washington, D. C., with the Eastern Section of the Seismological Society of America. The first session will be held in the library of the National Academy on Friday morning, May 1. Two additional sessions will be held in Coply Hall, Georgetown University, on Saturday morning and afternoon, May 2. Members of both organizations have been invited to present progress-reports on seismological projects or brief papers on special seismological investigations of general interest. The term of office of the secretary of the Section of Seismology of the American Geophysical Union expires on June 30, 1936. The chairman of the section has appointed the following Committee on Nominations: Frank Wenner (chairman), L. H. Adams and John P. Delaney, S.J. F. W. Sohon, S.J., of Georgetown University, is secretary of the Eastern Section of the Seismological Society of America and H. E. McComb, of the U. S. Coast and Geodetic Survey, is secretary of the Section of Seismology of the American Geophysical Union.

Nature states that the third International Congress for Investigation of Light will be held at Wiesbaden from September 1 to 7, under the presidency of Professor W. Friedrich, when discussions will be held on the biology and physics of light and treatment by light. Further information can be obtained from Dr. H. Schreiber, Robert Koch Platz 1, Berlin, N.W.7.

WITH the issue of the fourth number for 1935, *The American Fern Journal* has completed its twenty-fifth volume. Its publication was begun in the summer of 1910, and it was adopted as the official organ of the American Fern Society the following year. Three thousand four hundred and thirty-two pages have been issued, including both popular and technical articles on ferns and their allies from many viewpoints, and a cumulative index to this material is now in preparation. The editorial board consists of Dr. R. C. Benedict, Brooklyn Botanic Garden; Dr. William R. Maxon, U. S. National Museum; C. A. Weatherby, Gray Herbarium, and E. J. Winslow, of Brattleboro, Vermont. The surplus stock of back numbers is stored at and distributed from the Brooklyn Botanic Garden. The American Fern Society, which sponsors the *Journal*, is now over forty years old and has a membership of about 325, distributed through 33 states and 13 foreign countries.

THE London *Times* reports that two expeditions will leave Aberdeen shortly for Siberia and Japan to observe the total eclipse of the sun in June. One party will be stationed at Omsk, on the borders of Kirghiz and Siberia, and will be led by Professor J. A. Carroll, of the University of Aberdeen. The other expedition will be under Professor Stratton. Professor Carroll's party, which is being financed by the Joint Permanent Eclipse Committee, the University of Aberdeen, and private sources, will consist of Professor Carroll, William Alexander, Aberdeen, Miss F. K. McBain, assistant in the natural philosophy department, Aberdeen, E. G. Williams, Cambridge, and Captain S. I. Luck, London. They expect to leave London for Leningrad on April 22, reaching Omsk between May 5 and 10. The expedition will take twenty-five cases of instruments, weighing about three tons. Six weeks will be required to erect the instruments in concrete foundations and to adjust them. The duration of totality of the eclipse will be 135 seconds. At Omsk a supply of electricity for a variety of purposes, including warming the instruments at night and cooling them during the heat of the day, will be available.

ACCORDING to the London *Times* the Royal Society, which has been consulted by the British Secretary of State for the Colonies, has recommended that a scientific expedition should be sent to Montserrat in the Leeward Islands to undertake an expert investigation in connection with the occurrence of earth tremors in that Presidency, and to report to the Governor of the Colony. The Royal Society has undertaken to organize the expedition, and will contribute a sum of £300 towards the cost.

THE constitution of the Circolo Matematico di Palermo, revised to bring it in accord with recent legislation, appears in full in no. 1, vol. 59, of the Rendiconti. The president and vice-president are henceforth to be appointed by the Minister of Education (with the advice of the society); the editorial board of the *Rendiconti* as well as all other officers of the society are to be appointed by the president. The latter has full administrative powers, and only such business as he has placed on the agenda can be discussed in meetings of the society. The new constitution empowers the Minister of Education to further the expulsion from the society of any member unworthy of belonging to it; although the final decision presumably rests with the president, the society is ex-

ressly forbidden by the constitution to discuss or ote on such a matter. The by-laws of the society ust be approved by the Minister of Education. It provided that at least two thirds of the corresponding members must be Italian. At present less than one third are so, and the new constitution provides that no non-Italians be admitted to membership until the desired ratio is attained.

DISCUSSION

RIGIN OF THE SOUTHERN APPALACHIAN GRASS BALDS

WITH the opening of the Smoky Mountain National ark the attention of an increasing number of scienists will be directed to the southern mountain bald roblem. At the higher altitudes local grass areas arying from 1 to 100 acres in size are to be found harply delimited in a setting of either balsam-spruce orest or the high altitude deciduous trees, such as orthern red-oak or chestnut. Andrews Bald (alt. ,860 feet) on the end of a south spur of Clingman's ome Mountain, near the center of the park, is an xcellent example of a grass bald. Roughly approxiating a square in outline it presents 75 acres of early pure mountain oatgrass (*Danthonia compressa*), changing to a sedge (*Carex flexuosa*) at its pper wet margin. This luxuriant, deep-sodded, local rassland contrasts most amazingly with the dark rgin balsam-spruce forest which arises sharply on very side of it. From the depth of the humus layer nd from the asymmetric growth of the trees borderg it, the area is known to antedate the settling of e region by white men.

To plant ecologists of the eastern United States, e origin of the grass balds has been an unsolved iddle. If natural forces (including fire) have been volved, why haven't much larger areas of the high ountains in the last ten or twenty centuries gone over to "bald"? But the balds are mere dots on the ountain landscape.

On the basis of intensive studies made during the ast summer, the hypothesis is presented here that any of the grass balds are in reality ecological artifacts of Indian origin; they represent old Indian, igh mountain, summer camp sites, which when abanoned went through a ruderal stage into the oatgrass ubclimax, a community which under the climatic conitions of the high ridge and mountain tops of the outhern mountains is able to resist the invasion of e original forest almost entirely and to a marked egree the shrubs of the environment as well.

The Indian encampment hypothesis is supported by e following facts: Indians preferred the ridge trails or travel and hunting. The grass balds are generally ocated on broadly rounded ridge or knob tops (never n sharp ridges useless for camp purposes) and on the arm southern exposures of these. Unusually good prings may be found at or near the lower margins of the grass areas. Disturbed areas in certain balds were found in which the plant succession leading to the grass was taking place, a succession never noted following the destruction of the forest by logging or fire.

This grass bald succession into a subclimax may be observed frequently on the high altitude trails. In fact, many long trail sections in rather open forest are nothing but linear grass balds, showing in every respect the true bald character. And the initiation of these trail balds is wholly due to human interference operating at the soil level.

Fire in balsam-spruce is universally followed by the "fire-cherry" community, which under repeated fire succeeds itself by basal shoot regeneration. Fire alone can not explain the origin of the grass balds nor, it is believed, can any other natural factor or combination of natural factors.

A fuller presentation of this hypothesis is in preparation which, it is believed, will go far in solving the riddle of the origin of the Southern Appalachian grass balds.

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NORTH CAROLINA STATE COLLEGE

BEHAVIOR OF THYROID FOLLICLES IN THE HARVEY-LOOMIS CENTRIFUGE MICROSCOPE

AT Uppsala Universitet, with the collaboration of Professor The Svedberg and Kai O. Pedersen, I observed the extrusion of the colloid from the thyroid follicles in the ultra-centrifuge at a centrifugal force of 100,000 to 200,000 times gravity and the precipitation of thyroglobulin in the colloid immediately after its extrusion. It was observed that the thyroid cells were heavier than the colloid. In order to observe the details of this process I have placed rat and Necturus thyroid in the Harvey-Loomis centrifuge and observed it while subjected to a centrifugal force of 10,000 times gravity. This force is not sufficient to cause the colloid to pass through the connective tissue capsule of the thyroid follicle at any appreciable rate. However, the mechanism of its liberation from the thyroid follicle itself can be seen. Occasionally a number of cells of the thyroid follicle break loose and fall through the colloid, thus leaving a hole in the follicle through which colloid could escape if it could get out through the connective tissue layer. Since in the living animal there are lymph spaces and blood

vessels in this connective tissue layer there is, then, the means for transportation of the colloid into the general circulation. Since cells are not injured when subjected to centrifugal force of 200,000 times gravity and, yet, are sometimes separated by centrifugal force of 10,000 times gravity, this indicates that the cells are relatively loosely held together, and it seems probable that it would be much easier for the colloid to pass out between the cells than it would through the cells; in fact, nothing was observed to have been lost from the cells when they were subjected to centrifugal force of 200,000 times gravity and then made into histological preparations (3 μ thick) by Miss B. Sandin under the direction of Professor Erik Agduhr. These show (besides a displacement of chromatin in the nuclei) the displacement of cells of the follicular epithelium. Those of the rabbit show least displacement, those of the hog more, and those of a thyrotoxic human goiter most. Since Marine obtained symptoms of thyrotoxicosis by injection of thyrotropic hormone of anterior pituitary I tried the effect of thyrotropic hormone given me by Dr. Collip, on the Necturus thyroid in Ringer's fluid in the cell of the Harvey-Loomis centrifuge under a layer of oil to prevent evaporation. The cells of the thyroid treated with thyrotropic hormone were loosened more rapidly than those of a control slide without the hormone, but several days were required for complete loosening of the cells so that they would completely precipitate through the colloid in three minutes centrifuging at 10,000 times gravity. The colloid passed out of the connective tissue capsule after the precipitation of cells.

In Amphioxus the thyroid-homolog is a gland of external secretion. With its transformation into a gland of internal secretion the passage of secretion into the lumen still takes place. Some mechanism must be provided for the secretion to reach the general circulation. Since thyroglobulin has a molecular weight of nearly 700,000, being perhaps the largest molecule of a simple protein, diffusion through a semipermeable colloid membrane seems out of the question. This paper offers a suggestion. Conclusive observations could only be made on the living animal.

J. F. McCLENDON

UNIVERSITY OF MINNESOTA

EFFECTS OF ETHYLENE ON THE PLANT GROWTH HORMONE

IN view of the discussion of results of recent investigations of Hitchcock,[1] Van der Laan[2] and others in this journal,[3] it may be permitted to recall that the main conclusion expressed by Van der Laan reads as follows: "Alle diese Punkte weisen m.E. in die Richtung, dass die Bildung des Wuchsstoffes in der Zelle auf einen enzymatischen Prozess beruht."

If this consideration can be regarded as correct then we may bear in mind the conclusion expressed by Michener that all the effects of ethylene on growth are to be explained as indirect effects. This would be in agreement with earlier investigations to which we referred recently,[4] being also the foundation of practical results in the field of tobacco fermentation in the presence of minute quantities of certain gases, reported some months ago.[5]

F. F. NORD

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MIGRATION OF GRAY SQUIRRELS

IN SCIENCE for December 6, 1935, Ralph C. Jackson ventured an explanation of the migration of gray squirrels from New England into New York by postulating that red squirrels are responsible for the grays' emigration. Mr. Jackson says: "It is not generally known that a large percentage of gray squirrels are emasculated annually by the pugnacious reds. In years past the writer has shot and trapped alive a large number of gray squirrels and close observation showed 98 per cent. mutilation."

It seems logical to consider that (1) the testes of grays may be withdrawn into the abdominal cavity, except during the breeding season; (2) in immature squirrels the testes may not have migrated into the scrotum; (3) *Cuterebra emasculator* larvae may induce a condition that could be mistaken for castration. The actual emasculation of gray squirrels by reds remains a highly obscure and controversial point among zoologists and is in direct opposition to my experience with pet red and gray squirrels which were confined within the same cage.

According to Seton,[1] Merriam in "Mammals of the Adirondacks" (p. 226) and Jackson in "Wiscon. Mamm." (p. 87) consider the lack of food a causative factor in migrations of gray squirrels. It is interesting to note that this year there is a pronounced lack of winter food for gray squirrels in New England. Beech, acorn, and other nut crops were very slight this year. Game wardens and reliable woodsmen all over New England recently predicted a hard winter for gray squirrels. This information was imparted to the writer by questionnaires distributed while conducting a survey of winter food for wildlife. This factor

[1] Contributions from Boyce Thompson Institute, 7, 87; 1935.
[2] Thesis, Utrecht, 1934, p. 737.
[3] H. D. Michener, SCIENCE, 82: 551, 1935.
[4] F. F. Nord, SCIENCE, 79: 159, 1934.
[5] *Die Umschau*, 39: 202, 1935.
[1] E. T. Seton, "Lives of Game Animals," Vol. 4, Part 1.

may aid in explaining the recent small squirrel migrations, one of which is described by Mr. Jackson, but it by no means satisfactorily explains the ancient myriad gray squirrel migrations. It is also interesting to note that some of these ancient migrations occurred in areas outside of the range of the red squirrel.[2]

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DISPOSAL OF PAPERS

IN clearing my shelves, I propose to make up about 25 incomplete sets of my occasional papers. These relate mainly to astronomical subjects, and for the most part are summaries of solar work. Should some of the readers of SCIENCE be interested to write me requesting them, I shall be glad to present them as long as they last.

C. G. ABBOT,
Secretary

SMITHSONIAN INSTITUTION

QUOTATIONS

GERMAN SCIENCE GOOSE-STEPS

FEELING ran high during the World War among the science professors. French and German physicists were not easily reconciled. More recently we saw Soviet Russia trying to distinguish between capitalistic and communistic science and fanatically attempting to drag the dialectic materialism of Marx into the laboratory. But that there should be a mystic "Nordic" principle from which alone flows all that is fine in natural science, that Hindus, Greeks and Arabs should have contributed nothing to exact knowledge, that Einstein and relativity should be anathema because of his Semitic origin—it took the Third Reich to strike that note.

The controversy which is now being waged in Hitler's personal organ, the *Voelkische Beobachter,* on the superior qualities of "Nordic" research should make scientists everywhere blush for their vaunted objectivity. An obscure Willi Menzel may be dismissed when he trumpets the pre-eminence of "Aryan" science. But what shall be said when such leading physicists as Professor Johannes Stark and Philipp Lenard outdo him in blind hatred? Germany has sunk low indeed when it can found a new journal, *Deutsche Mathematik,* for no other purpose than that of substituting a narrow nationalism for the internationalism that has always ruled mathematics, when it is seriously proposed to change the inscription on one of the buildings of Heidelberg University from "Dem Lebendigen Geist" (To the Living Spirit) to "Dem Deutschen Geist," and when Nobel laureate Lenard can bring out the first volume of a great work on "Deutsche Physik" and dedicate it to Dr. Frick, Minister of the Interior, in this language:

> German Physics? one asks. I might rather have said Aryan Physics or the Physics of the Nordic Species of Man, the Physics of those who have plumbed the depths of Reality, seekers after Truth, the Physics of the very founders of Science. But I shall be answered, "Science is and remains international." It is false. Science, like every other human product, is racial and conditioned by blood.

High as anti-Semitism may run in the universities, Max Planck, Werner Heisenberg and Max von Laue reply to Stark and Lenard. Are theirs perhaps the more authentic voices? Evidently courage is not quite dead in the universities. Yet not since the time of Galileo has science been in such danger. It is impossible for a German biologist to write honestly on certain medical, anthropological or genetic topics without running the risk of imprisonment. Physics, mathematics, chemistry stepping out to Nazi music—it is a sad spectacle. With only approved meetings held in Germany and a Science Congress Center organized to trumpet the Nazi racial ideology at international scientific gatherings, the generous days when Japanese and Germans, Frenchmen and Americans, Italians and Scandinavians could meet and discuss science without a thought of country, race or religion seem almost like a nostalgic memory.—*The New York Times.*

SCIENTIFIC BOOKS

HUMAN GEOGRAPHY

Europe. By SAMUEL VAN VALKENBURG and ELLSWORTH HUNTINGTON. 651 pp., 139 maps, 14 pages of graphs, 6 pages of tables, separate English and foreign bibliographies and index. John Wiley and Sons, New York, 1935. Price $4.50.

TEACHERS of the geography of Europe have reason to feel favored, for within the past two years several really teachable texts in the field have been published. Not only has the number been greatly increased, but the quality of the new books has been consistently high; hence when one says that the book written by Van Valkenburg and Huntington, with its well-balanced physical, economic and cultural approach, is the

[2] *Ibid.*

most readable and teachable geography book on Europe, it is indeed high praise.

The Van Valkenburg-Huntington combination is a fortunate one, for these internationally known geographers represent European and American schools of thought; they are veteran travelers; they represent teacher as well as seasoned writer; they represent vigorous youth and sage maturity. The text will certainly not disappoint those who seek good authority in books.

The painstaking efforts of these authorities have resulted in a book which can be readily accepted as trustworthy in facts presented as well as conclusions drawn.

The book is on the whole interestingly written. The material of many regions is presented so vividly and with such clarity that one can readily see the writer treads familiar ground. In a few places, however, the style tends to become over-factual and uninteresting.

The book is, with its basic study of Europe as a whole followed by a logical sequence of countries within major regions, essentially pedagogical. However, it might have been improved by placing a few of the chapters of part one at the end of the book to act as a résumé for the detailed regional studies. Neither the balance between physical, economic and cultural subject-matter nor the space allotted to the individual countries can be adversely criticized, but perhaps too much space (225 pages) is given to part one, "Europe as a Whole."

The large number of maps, many of which are original, is a distinct asset to the book. On the whole, the cartographic work is excellent, though a few maps could have been improved by using more distinctive types of cross lining. On the mineral production map one can scarcely distinguish between the full dots and the half dots. The reviewer is of the opinion that it is unfortunate that no pictures were included in the book. A limited number of well-chosen pictures would have been a valuable asset even were it necessary in that event to leave out a few maps.

The mechanical make-up of the book is of the usual high John Wiley and Sons standard.

GORDON G. DARKENWALD

HUNTER COLLEGE OF THE CITY OF NEW YORK

The Geographic Pattern of Mankind. By JOHN E. POMFRET, xix plus 428 pp. Appleton Century Company.

"THE Geographic Pattern of Mankind" in the words of the editor "provides an imposing array of 'cases' by which geographic principles may be tested or to which they may be applied." These cases are selected from many sections of the world and include Equatorial Africa, Java, India, China, Japan, Russia, the Mediterranean Lands, South America, the Caribbean Lands, the United States and Western Europe.

In describing the life and pointing out relationships in these areas, Mr. Pomfret easily holds the reader's interest with a wealth of intriguing factual material. In fact he excites the curiosity so much in several places that the reader wishes to learn more about the particular subject and looks for a footnote that may lead him to a source of wider knowledge. Here he is disappointed, for a dearth of references is available for either actual quotations or for much material that must have been gathered from outside sources.

Although a treatment of "cases" makes up the major portion of the volume, this section is preceded by four chapters concerned with the elements of geography—"Human Geography and Culture," "Primary Laws," "The Elements and Theory of Climate" and "Climatic Types." The author's idea of laying the groundwork for a clearer understanding of the chapters to follow seems commendable, yet he failed to include any discussion of soils and physiography, and in his treatment of climate he failed to call attention to any of the well-known climatic classifications. Moreover, the careful reader is likely to question several generalizations and statements which fall short of exactness, both in the beginning chapters and in that section of the book devoted to "cases."

In spite of the shortcomings just pointed out and regardless of the fact that the book marks no new pathway in geography or supplies little that is original in approach, it is worthy of some of the editor's praise—"it surveys with rare judgment the various elements of modern civilization and shows with keen appreciation of values the many ways in which man is adjusting himself to diverse physical environments in various parts of the earth."

EARL B. SHAW

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SPECIAL ARTICLES

THE INVASION OF THE BODY BY ANIMAL POISONS

THE bleb formed by the intradermal injection of saline extracts prepared from the ground bodies of spiders, bees or mosquitoes rapidly flattens out and the injected fluid spreads through a large area of the dermis. A similar bleb formed by the injection of water or saline solution remains localized until the fluid is absorbed. The contrast is brought out if some inert colored material, such as dilute India ink, is added. With such an indicator measurements taken after 24 hours show that the area of spread of the

insect extracts are several times as large as that of the control. Parallel tests carried out with extracts of grasshoppers, ants, dragonflies and a number of other non-poisonous insects did not show any greater spread than that shown by saline alone.

The invasion of the tissues by these insect poisons can not, however, be compared with the extraordinarily powerful spreading power of snake venom. Fresh or desiccated venom from rattlesnakes in high concentration gives areas of spread as much as 20 times the area of the control. Dilutions as high as 1/100,000 still give areas of spread larger than that from saline solution. Cobra venom has similar properties. As a control to these tests extracts from the supralabial glands of such harmless species as chicken snake and pine snake proved to be devoid of any diffusing factor. This spreading action of the poison is shared if at all only to a limited extent by the extracts of several organs studied, including testicle, both from poisonous and non-poisonous snakes.

Naturally, the striking invasive power of the snake venom, as shown by the intensity of the local and general effects following snake bite, has always been known. It has even been pointed out that some fraction in the toxic complex must favor the rapid passage of the active components into the tissues and the blood. It is obvious that such a tremendous local diffusion of the snake secretion is not indispensable for the toxin to exert its action on the nervous centers. For instance, we have studied the poison from six different species of toads and, despite the fact that some of them killed the rabbit after a few hours, the local symptoms were either negligible or simply nonexistent.

The progress of the venom through the inoculated animal could perhaps be interpreted not as due to a selective permeation by a specific factor but to a sort of passive "flooding" of the highly damaged tissue by the venom components. In order to test this objection the rattlesnake venom has been treated by heat and hydrochloric acid, both of which treatments practically suppressed the local toxic power. Such detoxification left the spreading factor in the venom little impaired in activity. Moreover, the intradermal injection of unmodified venom into the dead rabbit or into the skin which has been nailed down on a board produces spreads which in their initial phases are identical with those taking place in the living animal. Of course, there is neither hemorrhage nor edema in the former case and a slight superficial necrosis around the needle puncture is noticed only with the venom at high concentration.

The simultaneous injection of venom together with vaccine virus or *Staphylococcus aureus* brings about a marked enhancement of the resultant lesions. The venom in these tests was used either heated and at high concentration or unheated and at high dilution. The heated venom also sharply and rapidly localizes the dyes injected into the blood stream, a phenomenon which has been noted with other materials having the spreading property.

From the experiments so far reported it would seem that the mechanism of invasion of the tissue by the venom of insects and *Ophidia* is essentially the same as the one already described by us for invasive bacteria.[1] In the case of staphylococcus a split of the necrotizing toxin from the spreading factor has been recently achieved in our laboratory. At present an attempt is being made to dissociate the spreading and toxic factors in snake venom.

Thus, a factor or a group of factors, the essential physiological property of which is to increase to a marked degree the permeability of mesodermic structures,[2] is found in such widely separated forms as poisonous insects, poisonous *Ophidia*, malignant mammalian tissues[3] and normal mammalian tissues, especially testicle.[4] It was the last-mentioned organ that was first found to possess a powerful enhancing action for infections.[5]

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SEXUAL PHASES IN THE QUOHOG*

THE question of change of sex in Pelecypod mollusks has received much attention during the past decade. Orton[1] has described the alternation of male and female phases in the European oyster (*Ostrea edulis*); Roughley[2] found that *O. cucullata* was likewise protandric and Amemiya[3] in his experimental work on *O. gigas* concluded that the sex of each oyster is determined during the winter, and that the preceding sexual phase has no influence upon the following ones. Coe[4]

[1] F. Duran-Reynals, *Jour. Exp. Med.*, 58: 161, 1933.

[2] D. C. Hoffman and F. Duran-Reynals, SCIENCE, 72: 508, 1930; *Jour. Exp. Med.*, 53: 387, 1931. D. McClean, *Jour. Path. and Bact.*, 33: 1045, 1930.

[3] F. Duran-Reynals and F. W. Stewart, *Am. Jour. Cancer*, 15: 2790, 1931. E. Boyland and D. McClean, *Jour. Path. and Bact.*, 41: 553, 1935.

[4] A. Claude and F. Duran-Reynals, *Jour. Exp. Med.*, 60: 457, 1934.

[5] F. Duran-Reynals, *Compt. rend. Soc. Biol.*, 99: 6, 1928; *Jour. Exp. Med.*, 50: 327, 1929; *ibid.*, 61: 617, 1935.

* Published by permission of the U. S. Commissioner of Fisheries.

[1] J. H. Orton, *Jour. Mar. Biol. Assoc.*, 14: 967–1045, 1926–27.

[2] T. C. Roughley, *Nature*, 124: 793, 1929.

[3] Amemiya, *Nature*, 116: 608, 1925.

[4] W. R. Coe, *Bull. Scripps Inst. Oceanog.*, Tech. Ser. 3: 119–144, 1932.

found an alternating sequence of male and female sexual phases in *O. lurida* and later[5] showed the protandric nature of the primary gonad of *O. virginica;* Burkenroad[6] and Needler[7] have also presented conclusive evidence of a change of sex in the latter species. Similar sexual phases have been found in the Pelecypod Teredo,[8] nearly all females passing through a preliminary functional male phase before reaching the definite phase of sexuality.

In an investigation of the life cycle of *Venus mercenaria* the writer has found similar evidence of protandry. Young clams, when only 0.6–0.7 cm long, collected on the clam beds of Long Island Sound, near Milford, Conn., in October, were found to possess distinctly bisexual gonads with very strong male predominance. In the majority of cases fully ripe spermatozoa occupied the central part of the lumen, while small ovocytes and indifferent gonia constitute the inner walls of the follicles. Rapid spermatogenesis thus gives the primary gonad the appearance of a spermary. Apparently functional spermatozoa are found in the follicles of many young clams of this minute size throughout the winter.

The following spring the follicles are gradually extended dorsally and posteriorly until they occupy the spaces around the stomach and between the digestive gland and the muscular body wall. The character of gonads remains essentially similar to that described above. Unless carefully examined, many of the animals of this stage may be taken for true males, but the presence of young ovocytes, showing distinct mitochondrial bodies and yolk nuclei, indicates the bisexual character of the gonads. It is interesting to note that although in all cases the gonads exhibit a predominantly male appearance, many degrees of intersexuality may be recognized. Some of the follicles may possess only a few small ovocytes, while in other follicles they are larger and much more numerous. Quite often such differences are observed in the follicles of the same individual as Coe[5] has reported for the oyster.

In the middle of the summer, when the water temperature reaches the critical point, the ripe spermatozoa are discharged. Soon afterwards two distinct types of individuals become distinguishable, as definitive males and females. In the males a second period of spermatogenesis begins in the autumn and continues at a reduced rate throughout the winter. In the spring, with the increase of water temperature, rapid branching of gonad follicles takes place simultaneously with increased rate of spermatogenesis. The gonads then have the typical male character of the adult. The sperm are discharged later in the summer, when the size of the shell has reached a length of 3 cm or more.

In those young individuals destined to become females the lumen of the follicles remain empty after the spermatozoa are discharged. At the end of the initial male phase the gonad follicles remain distended with only a thin layer of undifferentiated cells and small ovocytes along the inner walls. In many cases numerous phagocytes invade the follicles and devour the pycnotic and degenerated male cells. Ovogenesis begins in early spring. In June and July the follicles contain mature ova. The animals, formerly functioning as males, have now reached the stage of functional females.

The adults are, with few exceptions, of separate sexes. Among several hundred mature clams studied by means of serial sections only two cases of functional hermaphroditism have been observed. Nevertheless, examination of gonads of adult males reveals in almost every instance the presence of small ovocytes somewhere along the walls of the follicles. This may indicate the potentiality of changing the sex even in the adult condition. So far there has been no evidence obtained to warrant such a conclusion. Spermaries of adult males contain mature spermatozoa at all seasons of the year with exception of a short post spawning period. When placed in the sea water, spermatozoa, after 2 to 3 minutes of quiescence, begin to swim actively in their typical spiral way. This simple experiment was tried at bi-weekly intervals throughout the year and always with positive results. The ovaries of adult females also contain large ova at all seasons of the year. In fact, little difference will be noted on superficial examination of samples collected in December and in June. In both cases the follicles are large, distended and filled with large ovocytes. In this respect the quohog differs remarkably from the American oyster, in which only shrunken follicles are found during the autumn and winter.

Thus, in *Venus mercenaria,* as in the other pelecypod mollusks to which reference has been made, the protandric nature of primary gonads has been established. However, the quohog is not exclusively protandric, because a few individuals develop into females without passing through a functional male phase. In this respect there is again a similarity between the quohog and the various species of oysters in which likewise the primary male phase may be omitted or aborted.

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[5] W. R. Coe, *Biol. Bull.*, 63: 419–441, 1932.
[6] M. D. Burkenroad, SCIENCE, 74: 71–72, 1931.
[7] Alfreda B. Needler, Prog. Rept. Atlantic Biol. Sta. and Fish. Exp. Sta., No. 5, 1932.
[8] Wesley R. Coe, *Biol. Bull.*, 65: 283–303, 1933.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

GYROSCOPES AND TOPS WITH BALL BEARINGS

IN the usual form of gyroscope, the spinning member is attached to one end of a rod and a counter weight to the other. The rod is supported at its center by a stand in such a way that it can rotate about one horizontal axis and the vertical axis. The gyroscope is thus free to move up and down in nutation and also to rotate about the vertical axis in precession. If, however, the rod is placed in a bearing at the point of support (Fig. 1) it can also rotate about its own axis.

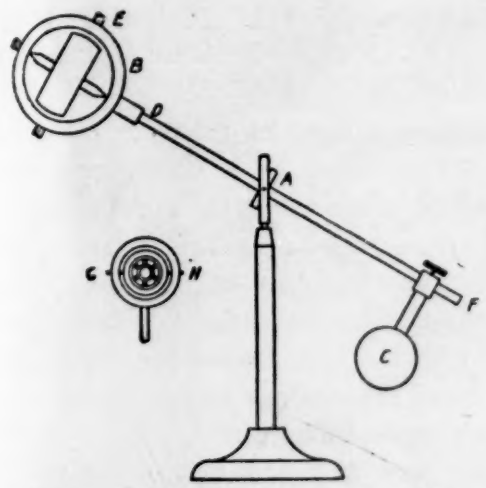

FIG. 1. The rod FD turns in the bearing at A; the bearing turns about a horizontal and vertical axis; the counterweight C is adjustable. The frame of the rotating member B is screwed to the rod at either D or E. GH shows the mounting of the bearing at A.

This gives another degree of freedom to the top and if the counter weight is placed on a second rod as shown in the diagram, it is possible to give two couples to the gyroscope. In this way the different types of precession and nutation can be shown as desired. The frame which contains the spinning wheel of the gyroscope may be screwed into the rod in three different ways so that the plane of the rotating wheel may be (a) parallel to the rod, (b) perpendicular to the rod in a horizontal plane, (c) perpendicular to the rod. In all three positions, the gyroscope, on account of the bearing, will give many new combinations of nutation and precession.

The mathematical theory of tops shows that it is extremely difficult to make a tall thin top (such as a lead pencil) stand up while spinning. The reason for this is that a tall top must be rotating at a very high speed. We have designed a special type of tall top which we spin by means of a rotating magnetic field. This field is produced by a spinner (Fig. 2) consisting of a laminated iron core with a two-phase winding

[1] Preliminary note.

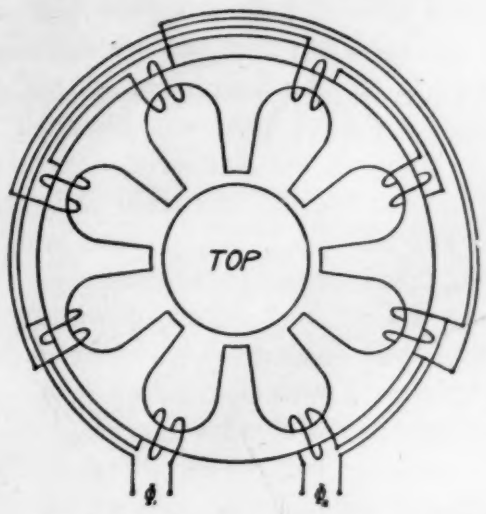

FIG. 2. Laminated iron spinner with two-phase windings for producing the rotating magnetic field.

on it. An Alexanderson alternator supplies the high frequency alternating current for the spinner. When the top is placed in the rotating magnetic field, it is caused to rotate as an induction motor. Thus with an input frequency of 600 cycles, the speed of the top is nearly 600 revolutions per second (36,000 revolutions per minute). The top itself consists of a solid copper disk (Fig. 3, A) two inches in diameter and one inch thick, attached to a five-inch spindle (C) by means of a high-speed ball bearing, B. The spindle of the top is held in the hand and the copper disk is placed in the rotating magnetic field of the spinner. This top will stand upright at first, but as air friction reduces its speed, it will gradually lean over and will finally precess in an almost horizontal position. In this position, centrifugal force (which is usually neglected in theory) will cause the point of the spindle to describe a spiral. This particular top spins best on a fairly rough surface.

FIG. 3. The Top.

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N. I. HALL

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MOUNTING MEDIUM FOR CLEARED SPECIMENS

THE interest shown at the St. Louis meeting in our cleared specimens of frog tissue mounted in Petri dishes and the requests for further information about

our demonstration encourage us to offer this brief account of our methods.

The arterial system of the frog was injected in the usual way and the whole frog was dehydrated, cleared and mounted in oil of wintergreen. A well-injected and adequately cleared frog was dissected for the purpose of studying the course of certain arteries, especially in the tongue, tympanic and nictitating membrane and the fat bodies. These parts of the frog were at first mounted on a microscopic slide and immersed in a Petri dish of oil of wintergreen for careful inspection under a binocular microscope. Later the specimens were mounted on celluloid, which began to soften in the oil of wintergreen and finally dissolved completely without any harm to the tissue. In the course of several weeks some of the oil evaporated, leaving the cleared tissue embedded in a solid medium. Quantitative experiments show that at least 25 grams of celluloid will dissolve in 100 cc of oil of wintergreen and that by adding acetone up to 20 cc a few more grams of celluloid will dissolve in the same amount of oil. However, care must be had in the use of acetone, as it may cloud the cleared specimen and discolor the celluloid-oil mounting medium.

After a sufficient quantity of celluloid has been dissolved in the oil of wintergreen any entrapped air may be removed with the pump. This stock may be kept for months without any noticeable deterioration or marked hardening; it will remain sufficiently labile to be poured into the Petri dishes when the cleared specimens are ready. Air bubbles may again cause some trouble, but they soon come to the surface and explode. When the specimen is properly oriented, the air bubbles have disappeared and the medium has set to the shape of the container, the cover of the Petri dish can be sealed on by forcing the air ahead of the celluloid-oil mounting medium as the two parts are brought slowly together. The medium seems to harden from week to week, does not discolor, does not shrink or crack. The Petri dish may be handled in any way, on edge or upside down; may be put in the hands of students as demonstration material; may be used for other than cleared specimens, such as small jellyfish or sea serpents which are thoroughly dehydrated before being mounted.

Should it be necessary to remove the cover of the Petri dish at any time put a few drops of acetone or oil of wintergreen around the edge where the two dishes are sealed together by the medium and turn the cover slowly until completely loosened. If the specimen is to be taken out of the medium cut around it carefully and lift out the block which can be put in fresh oil of wintergreen and soon the specimen will be freed from the mounting medium and in as perfect a condition as if it had never been used.

Whole animals, dissected parts, delicate tissues and individual injected blood vessels have been mounted during the past six months with perfect satisfaction from this celluloid-oil combination. The celluloid is obtained from any large stationery supply company in 20×50 inch sheets; the synthetic oil of wintergreen is quite satisfactory; the 50 and 70 mm Petri dishes are good for small specimens; the quantity of the medium to be made up will depend on the size of the specimen to be mounted.

PAUL L. CARROLL, S.J.
JAMES R. NEIDHOEFER

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MILWAUKEE

APPLICATION OF THE PRINCIPLE OF THE ROSIWAL PETROGRAPHIC ANALYSIS TO GEOGRAPHIC RECONNAISSANCE

THIS method is based on the principle that the percentages of surface areas of differentiated types correspond to the sum of their intercepts on linear transects across the total area, reduced to percentages. The method proposed is to lay out a number of traverses across an area under consideration such that the total length of the traverse is not less than one hundred times the average length of the intercept of the various types differentiated. The field man paces each of the traverse routes and records the length of intercept of each type of land character. The fractional system of notation, now in common use by field geographers,[1] may be used in juxtaposition to the traverse line platted either in the notebook or on a suitable base map. Supplementary information should be kept in the note record. The amount of detail recorded on these traverses will vary with the aims and purposes of the reconnaissance. The results obtained are quantitative as well as qualitative. The method has the advantage of covering areas away from road frontage and thus gives a more accurate picture of the areal content of the region as a whole. It requires a minimum of equipment and but one worker. It is estimated that at least 50 square miles can be covered in a week. Furthermore, office analysis of land use maps is facilitated by this method, as it eliminates tedious planimeter measurements.

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[1] See V. C. Finch, Geog. Soc. of Chicago, *Bull.* 9, Pt. II, 1933.

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